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COMBINING NONCONTINGENT REINFORCEMENT AND DIFFERENTIAL REINFORCEMENT SCHEDULES AS TREATMENT FOR ABERRANT BEHAVIOR

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Research has shown that noncontingent reinforcement (NCR) can be an effective behavior-reduction procedure when based on a functional analysis. The effects of NCR may be a result of elimination of the contingency between aberrant behavior and reinforcing consequences (extinction) or frequent and free access to reinforcers that may reduce the participant's motivation to engage in aberrant behaviors or mands. If motivation is momentarily reduced, behavior such as mands may not be sensitive to positive reinforcement. In this study, for 3 children with aberrant behavior maintained by tangible positive reinforcement, differential-reinforcement-of-alternative-behavior schedules were superimposed on NCR schedules to determine if mands could be strengthened. Results for the participants indicated that NCR did not preclude reinforcement of mands.

DESCRIPTORS: self-injurious behavior, tangible positive reinforcement, noncontingent reinforcement, differential reinforcement

Differential reinforcement procedures are the most commonly used treatment for aberrant behavior (Lennox, Miltenberger, Spengler, & Erfanian, 1988; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993a). These procedures are appealing because they involve both withholding reinforcement contingent on an aberrant response (extinction) and delivering reinforcement contingent on other behavior (e.g., mands).

Despite the appeal and widespread use of differential reinforcement procedures, several potential limitations remain (Vollmer et al., 1993a). First, the procedure can be cumbersome (i.e., care providers are required to attend to or observe the client at all times, either to reset an interval timer or to provide reinforcement in the absence of the target response during an interval). Second, as a result of its extinction component, differential reinforcement can produce side effects (e.g., increased rate or magnitude of behavior, new forms of aberrant behavior, emotional responding). Finally, differential reinforcement potentially produces low rates of reinforcement (e.g., the client produces high enough rates of target behaviors to continuously reset the intervals, resulting in extended time passage before reinforcement).

In an attempt to circumvent the problems associated with differential reinforcement procedures, Vollmer et al. (1993a) and Hagopian, Fisher, and Legacy (1994) examined noncontingent reinforcement (NCR) as a reductive procedure. NCR was developed based on the results of a functional analysis and consisted of three components: (a) NCR, during which a fixed-time schedule determines when the individual will receive access to preferred reinforcers during the session, independent of occurrences of aberrant or adaptive behaviors; (b) extinction, during which the experimenter provides no programmed consequences contingent on the aberrant target behaviors; and (c) fading, in which the schedule of noncontingent reinforcement is gradually decreased from a

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dense (continuous) to a lean schedule (e.g., one delivery per 5 min).

Vollmer et al. (1993a) compared the effects of a differential-reinforcement-of-other-behavior (DRO) schedule with NCR. The results of the study indicated that both DRO and NCR were viable treatments for reducing SIB maintained by social attention. However, the NCR procedure was more efficient for suppression of self-injurious behavior (SIB), reduced extinction-related side effects in 2 of 3 participants, was less cumbersome to implement, and provided the participants with significantly higher rates of reinforcement. Hagopian et al. (1994) extended the work of Vollmer et al. (1993a) by conducting a partial component analysis of the NCR procedure. The results replicated the Vollmer et al. (1993a) findings and demonstrated that fading was an important component of the NCR package. A third study (Vollmer, Marcus, & Ringdahl, 1995) extended the NCR findings to noncontingent escape in the treatment of SIB maintained by negative reinforcement.

Although the emerging results of NCR procedures are encouraging, one potential limitation of NCR has not been addressed in previous research. That is, the NCR component of the package (providing access to reinforcers at high rates) may lead to a momentary decrease in the participant's motivation to engage in either aberrant behavior or adaptive behavior (e.g., mands). If the NCR component leads to reduced motivation, an alternative adaptive response may be relatively insensitive to reinforcement, reducing the utility of the procedure. If, however, response suppression is a function of extinction (because the contingency between the aberrant response and the reinforcer is eliminated), the mand may be responsive to reinforcement.

The purpose of this study was to further examine the mechanisms responsible for NCR effects and to examine a potential negative side effect of the procedure. More specifically, we (a) combined NCR and DRA (with 3 participants) to ascertain whether NCR precluded reinforcement of a mand and (b) combined NCR and differential reinforcement of alternative behavior (DRA) with 1 participant to establish an interval-based reinforcement schedule. Reinforcement was delivered only after a prespecified amount of time. Therefore, the participant needed to wait before the opportunity to contact reinforcement became available.

NCR plus DRA may be a useful intervention package because the NCR component reduces the need for caregivers to reinforce mands at all times, and the DRA component provides for communication or skills training at appropriate times of day with reduced risk of extinction bursts. Thus, the DRA component removes one limitation of NCR (no explicit contingencies are provided for learning adaptive behaviors), and the NCR component reduces the probability of extinction bursts associated with DRA.

GENERAL METHOD

Participants and Setting

Sally, Rob, and CJ participated. Rob and CJ attended a noncategorical public preschool. Sally attended a public, integrated, regular education preschool. All 3 participants were selected based on a referral for assessment and treatment of severe behavior problems. They were the first 3 children for whom the results of a brief functional analysis showed a differential sensitivity to positive reinforcement in the form of contingent access to tangible items (Iwata, Dorsey, Slifer, Bauman, & Richman, 1982/1994; Vollmer, Iwata, Zarcone, Smith, & Mazaleski, 1993b). The tangible items used in the functional analysis were selected based on the results of a choice assessment (Fisher et al., 1992) and on parent and teacher reports

that the items were correlated with problem behavior. (The functional analysis results are available from the authors upon request.)

Sally was a 5-year-old girl who had been previously diagnosed with Down syndrome, language delay, and speech articulation difficulties. Although specific description of Sally's intellectual functioning was unavailable, she appeared to function in the moderate range of mental retardation. She had a history of SIB, aggression, and disruption. Her speech consisted of simple functional sentences and naming objects. Her academic skills consisted of naming shapes and colors, counting to 20, and identifying the letters of her name.

Rob was 4 years old and appeared to be functioning in the profound range of mental retardation. He was referred for treatment of aggressive behaviors. He exhibited no speech or functional gestures aside from reaching for preferred items. He had been treated previously for hand mouthing by our clinical research team, but the hand-mouthing treatment was not related to this study (the behavior was not maintained by social reinforcement).

Five-year-old CJ was diagnosed as having autism. He was referred for treatment of severe tantrum behaviors including SIB, aggression, and disruption. Although CJ often led a caregiver to preferred items and was able to operate a stereo, keyboard, computer, and microwave independently, he had a limited nonfunctional vocal repertoire that consisted of occasional immediate and delayed echolia.

All sessions were conducted in an unoccupied room in the child's school. Items in the room varied depending on the specific assessment or treatment condition. Depending on the participant's daily schedule, two to four 10-min sessions were conducted 4 days per week for Rob and CJ and 5 days per week for Sally.

Target Responses

Self-injury was defined as any audible contact between the head and hand, wall, floor, or table (Sally, CJ). *Aggression* was defined as hair pulling (grasping and pulling hair with fingers) or forceful hitting, kicking, or pinching others (Rob, Sally). *Tantrums* were defined as head banging, head hitting, audible kicks to objects, and crying (CJ). Sally's mand was defined as saying the word "toys"; for Rob it was touching the therapist's hand or touching a response card (27.7 cm by 20.5 cm) with the words "toys please" printed on it; for CJ it was touching the palm of the therapist's hand, manually signing "music," or vocally saying "music." *Tangible reinforcement* was defined as providing the participant with access to preferred items or toys during a 10-s interval.

Data Collection and Interrater Agreement

Dependent measures were individualized. For Sally, the dependent measure was responses per minute of SIB; for Rob, it was responses per minute of aggression; for CJ, it was percentage of 10-s intervals with tantrums. Data were collected on hand-held computers (Assistant Model A102) or on a laptop computer by previously trained observers seated in a corner of the room.

A second observer simultaneously and independently recorded data with a primary observer during interobserver agreement checks for at least 20% of all sessions within each condition, with the exception of Sally's baseline conditions (16.7% of the sessions). In all cases, interobserver agreement was calculated by dividing a session into consecutive 10-s intervals. For frequency recording, the smaller number of observed responses was divided by the larger number of observed responses in each interval, and these values were averaged across the session. For partial-interval response recording, the number of agreements (that a response occurred

during the interval or did not occur during the interval) were divided by the total number of intervals, and these values were averaged across sessions. Interobserver agreement means exceeded 95% for all dependent variables in all conditions.

Experiment 1: Sally

The purpose of this experiment was to determine if a mand could be maintained while tangible reinforcers were made available on a noncontingent schedule.

Design and Procedure

Treatment was evaluated in a reversal design. During baseline, the experimenter presented tangible stimuli to the participant prior to the beginning of the session. When the session began, the items were removed from reach or manipulation; however, the items remained visible and were presented to the participant contingent on SIB and remained available until a set point in time (once every 30 s). Specifically, the items were removed at the beginning of each session, minute, or 30-s interval. Thus, if Sally engaged in SIB at 2 min and 20 s into the session, she was permitted access to the items for only 10 s (the end of the 30-s session interval). However, if she engaged in SIB at the 3-min session interval, she was given access to the items for 30 s (until the next 30-s session interval). The tangible stimuli were the same items used in the functional analysis. During NCR plus DRA, Sally could obtain preferred toys in either of two ways: (a) noncontingently, on a fixed-time (FT) schedule, or (b) contingent on a mand (i.e., a vocalized request). There were no programmed consequences for SIB.

Noncontingent tangible reinforcement was provided for 20-s intervals on a predetermined FT schedule. The toy was removed after the interval unless another NCR interval immediately followed. The schedule of noncontingent reinforcer delivery was faded across sessions as follows: 3 per minute (continuous access), 2 per minute, 1 per minute, 0.5 per minute, 0.33 per minute, 0.25 per minute, and 0.2 per minute. Criteria for schedule progression were similar to those described by Vollmer et al. (1993a). However, progression of the schedule occurred only after rates of SIB were at or below 0.3 responses per minute for one session. In addition, if Sally's SIB rate was above 0.3 responses per minute for two consecutive sessions and an upward trend was noted, the schedule reverted to the previous schedule (Hagopian et al., 1994).

To fulfill the DRA component, Sally also could obtain toys for 20 s contingent on a mand (i.e., saying "toys"). Prior to the NCR plus DRA condition, Sally was taught to say "toys" via imitation and reinforcement procedures. Initial training was completed in a practice session lasting about 15 min. Training consisted of modeling the mand and immediately reinforcing imitative behavior with 20 s of access to preferred toys. Gradually, modeled responses were delayed to provide opportunities for independent responses (Matson, Sevin, Box, Francis, & Sevin, 1993). Training was completed once she independently exhibited the mand within 30 s after preferred items were withdrawn for three consecutive trials. The purpose of training was to ensure that some baseline level of the mand was occurring prior to the treatment condition. Each subsequent treatment day was started with a remedial training session.

Results and Discussion

The top panel of Figure 1 shows that the NCR plus DRA package almost immediately suppressed Sally's SIB. During baseline conditions, Sally exhibited an average of 5.8 self-injurious responses per minute (range, 2.2 to 11.0). During treatment conditions, SIB rates averaged 0.16 responses per minute (range, 0 to 2.4). In addition, mand rates

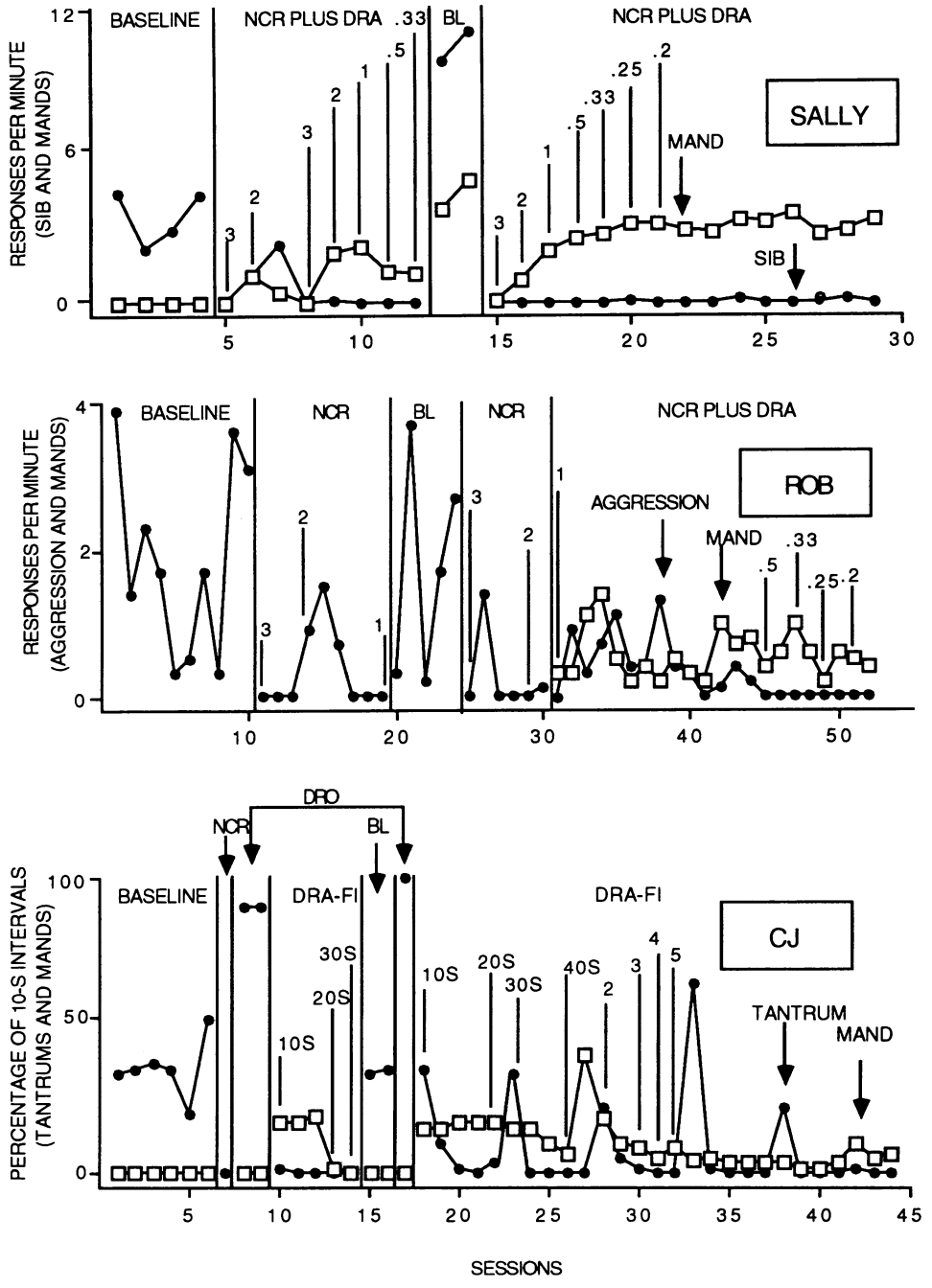

Figure 1. Upper panel: Responses per minute of SIB and mands across baseline and NCR plus DRA conditions for Sally. Lines marked with time intervals point to sessions in which NCR or DRA intervals were changed; numbers represent the rate of NCR delivery. Middle panel: Responses per minute of aggression and mands across baseline, NCR, and NCR plus DRA conditions for Rob. Lines marked with time intervals point to sessions in which NCR or DRA intervals were changed; numbers represent the rate of NCR delivery. Lower panel: Percentage of 10-s intervals with tantrums and mands across baseline, NCR, DRO, and DRA FI conditions for CJ. Lines marked with time intervals point to sessions in which the FI schedule was changed.

were maintained at high levels (M = 1.7 per minute) and increased as NCR was faded. Thus, the NCR component did not preclude reinforcement of alternative responding.

Sally's treatment analysis examined the effects of teaching a mand in conjunction with an NCR schedule. However, at times it may be preferable to implement an NCR procedure first and later add additional treatment components (Hagopian et al., 1994). The purpose of Experiment 2 was to replicate the results from Experiment 1 and to determine if a DRA procedure could be superimposed on a preexisting NCR schedule.

Experiment 2: Rob

Design and Procedure

For Rob, treatment was evaluated in a reversal design. Baseline was identical to the one described for Sally, except that the target aberrant response was aggression. The NCR schedule was identical to the one implemented with Sally, except that schedule progression occurred only after Rob exhibited 0.2 or fewer responses per minute for two consecutive sessions. The NCR plus DRA phase was similar to the one described for Sally, except that Rob's mand consisted of touching a response card with the words "toys please" written on it. The card was located on a table in the session room. Prior to Session 43, Rob was taught an additional mand (touching the experimenter's hand) to allow him to obtain reinforcement when he was away from the table.

Results and Discussion

The results, depicted in the middle panel of Figure 1, show that NCR suppressed inappropriate behaviors. Rob exhibited an average rate of 1.8 aggressive behaviors per minute during baseline (range, 0.2 to 3.9) and an average of 0.4 aggressive behaviors per minute (range, 0 to 1.5) during treatment conditions. During the final phase (NCR plus DRA), when reinforcement was provided on an FT schedule and contingent upon mands, aggression initially increased and then decreased to zero for the final eight sessions. The mean rate of mands averaged 0.56 responses per minute (range, 0.2 to 1.4) during this phase. As with Sally, NCR did not preclude establishment and maintenance of a mand for Rob.

During Experiments 1 and 2, the mands were reinforced on a continuous schedule (i.e., each time the mand occurred). However, in some situations, not all mands can (or should) be met with immediate reinforcement. For example, if a parent is attempting to prepare dinner, answer the phone, or monitor other children, he or she may find it impossible to immediately provide contingent reinforcement. In such cases, a delay to reinforcement for the DRA component may be required. One advantage of prior NCR schedules is that reinforcer–reinforcer intervals can be increased gradually. By combining NCR and DRA, mands for reinforcers could be made available only after a predetermined amount of time, similar to a fixed-interval (FI) reinforcement schedule. The purpose of Experiment 3 was to evaluate the effects of an FI DRA schedule that was similar to NCR in that (a) reinforcement was available only at prespecified times beginning with a dense schedule (i.e., 50 s of reinforcement during each minute of the first session), (b) the reinforcement schedule was faded across sessions (i.e., 20 s of reinforcement once every 5 min during the last session), and (c) the contingency between aberrant behavior and reinforcement was discontinued (i.e., extinction). DRA FI differed from NCR in that reinforcement was presented contingent upon mands. With many DRA and all DRO schedules used to treat aberrant behavior, reinforcement is delivered only when aberrant behavior is absent (e.g., the participant is required to engage in no instances of aggres-

sion for 1 min to access the reinforcer), and every instance of aggression results in the timer being reset to 1 min. This omission contingency for aberrant behavior (i.e., reinforcement is delivered only when aberrant behavior is absent) is similar to a changeover delay (COD; Pierce & Epling, 1995). However, with this DRA FI schedule, as with NCR, reinforcement was delivered independent of the occurrence or nonoccurrence of aberrant behavior. A potential advantage of a DRA FI schedule over other differential reinforcement schedules that include an omission contingency is that bursts of aberrant behavior associated with the absence of reinforcement are less likely. A potential advantage of this DRA FI schedule over NCR is that a mand may be established and maintained.

Experiment 3: CJ

Design and Procedure

For CJ, treatment effects were evaluated using a reversal design. Baseline was similar to the one described for Sally in Experiment 1 except that toys were presented contingent upon tantrums. During the NCR probe, CJ had free access to preferred toys or items throughout the session, and there were no programmed consequences for tantrums or the mand. During differential-reinforcement-of-other-behavior (DRO) probe sessions, the preferred toys or items were presented to CJ for 20 s contingent on a 10-s interval during which tantrums were absent. There were no programmed consequences for the mand during DRO.

During DRA FI, the mand was reinforced on an FI schedule, and there were no programmed consequences for tantrums. During the first DRA FI session, the FI interval was set at 10 s and the reinforcement interval was set at 50 s. Thus, the first mand emitted by CJ after 10 s had elapsed was reinforced with 50 s of access to preferred toys or items. If CJ emitted a mand before the 10-s interval had elapsed, the therapist said, "Thanks for asking, CJ, but you need to wait." The FI schedule progressed from FI 10 s to FI 5 min, in the following sequence: FI 10 s, FI 20 s, FI 30 s, FI 40 s, FI 2 min, FI 3 min, FI 4 min, and FI 5 min. Access to tangible stimuli was 20 s except during FI 10 s (access was 50 s per minute), FI 20 s (access was 40 s per minute), and FI 30 s (access was 30 s per minute). Interval fading occurred only after the percentage of intervals with tantrums was at or below 5% per 10-min session.

Results and Discussion

The bottom panel of Figure 1 shows that target inappropriate behaviors did not occur in the NCR probe session when CJ had continuous access to preferred reinforcers. However, inappropriate behavior increased from 35% of intervals during baseline (range, 20.0% to 53.3%) to an average of 93.3% of intervals during the DRO probe sessions (range, 90.0% to 100%). During DRA FI, tantrums decreased to an average of 6.9% of intervals (range, 0.0% to 64.0%). In addition, mands averaged 10.1% of intervals (range, 0% to 40%) during DRA FI. A downward trend of mands was exhibited during DRA FI treatment sessions because CJ often waited up to 5 min before requesting reinforcers. Thus, CJ's behavior was sensitive to the changing FI schedule requirements.

GENERAL DISCUSSION

This study extends previous NCR research in four ways. First, results for the first 2 participants suggest that NCR did not preclude reinforcement of alternative request behaviors (i.e., mands). That is, Sally and Rob learned to mand for items that were periodically presented on a noncontingent schedule.

Second, rates of inappropriate behavior remained lower than baseline levels, and mands were strengthened when a DRA schedule was superimposed on a previously existing NCR schedule. More specifically, Rob's treatment intervention was a two-step process. First, Rob was presented with items on a noncontingent schedule. Second, a DRA component was superimposed on the existing NCR schedule. At times, it may be difficult for caregivers to implement a multicomponent intervention (Hagopian et al., 1994); thus, a stepwise progression of treatment components may be appealing.

Third, a delay-to-reinforcement period was established using fixed-interval schedules. That is, CJ was taught to wait before requests to receive preferred stimuli were reinforced. Furthermore, CJ's percentage of tantrums was significantly reduced during intervals in which he did not have access to preferred items. Fixed-interval schedules are compatible with both NCR and DRA because reinforcer delivery is noncontingent with respect to aberrant behavior but contingent with respect to alternative behavior.

In addition, for 2 participants, NCR was an effective treatment for behavior maintained by tangible positive reinforcement as opposed to attention or escape; this result extends the findings of Vollmer et al. (1993a), Hagopian et al. (1994), and Vollmer et al. (1995). Finally, the NCR plus DRA procedures were implemented for participants who exhibited various behavioral topographies including SIB, aggression, and tantrums. Combined, these extensions support the generality of NCR-based interventions.

The results of this study also suggest possibilities for further research. First, to increase external validity, the present study should be extended to include environmental manipulations outside of the analogue treatment setting. For example, the treatment conditions could be implemented in the classroom or the home, with teachers or peers and parents or siblings acting as therapists. Second, future research might further analyze the necessary and sufficient components of NCR. Although Hagopian et al. (1994) demonstrated that a fading component was necessary to increase the reinforcer–reinforcer interval in NCR, the essential parameters of the fading schedule remain unknown. It may be possible to fade the density of reinforcement much more rapidly.

Some methodological issues also arise from the present study. First, because empirically derived tangible reinforcers were used in a functional analysis and baseline, it is conceivable that the aberrant behavior could have been shaped and acquired during the assessment. However, it should be noted that, upon referral, parent and teachers reported that problem behavior was correlated with removal of specific tangible stimuli. Also, in the functional analysis, the target behavior was observed immediately for all 3 participants; we observed no acquisition curve.

Second, it could be argued that baseline rates of aberrant behavior were artificially inflated due to frequent reinforcer withdrawal. Indeed, we suspect that higher overall rates of the target behavior were observed in our functional analysis and baseline conditions (in comparison to the natural rate). Inflated rates of aberrant behavior are likely in any analogue assessment in which the provoking and reinforcing events are deliberately arranged to occur at high rates. However, in most cases, clinical researchers are more interested in identifying and evaluating the mechanisms that maintain aberrant behavior and less in the absolute magnitude or rate of responding. Thus, it may be important in future investigations to evaluate the extent to which response–reinforcer relationships identified under analogue conditions also occur in other settings and whether treatments

found to be effective in analogue situations also work in the natural environment.

In comparison to other interventions currently used to decrease inappropriate behavior maintained by positive reinforcement (extinction, differential reinforcement, NCR), the combined NCR plus DRA package maintains the established advantages of NCR while addressing its limitations. That is, the procedure effectively eliminates the contingency between the aberrant behavior and the reinforcer and teaches the participant to mand. Therefore, the NCR plus DRA package may serve as a useful substitute (or adjunct) to current interventions for inappropriate behavior maintained by positive reinforcement.

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